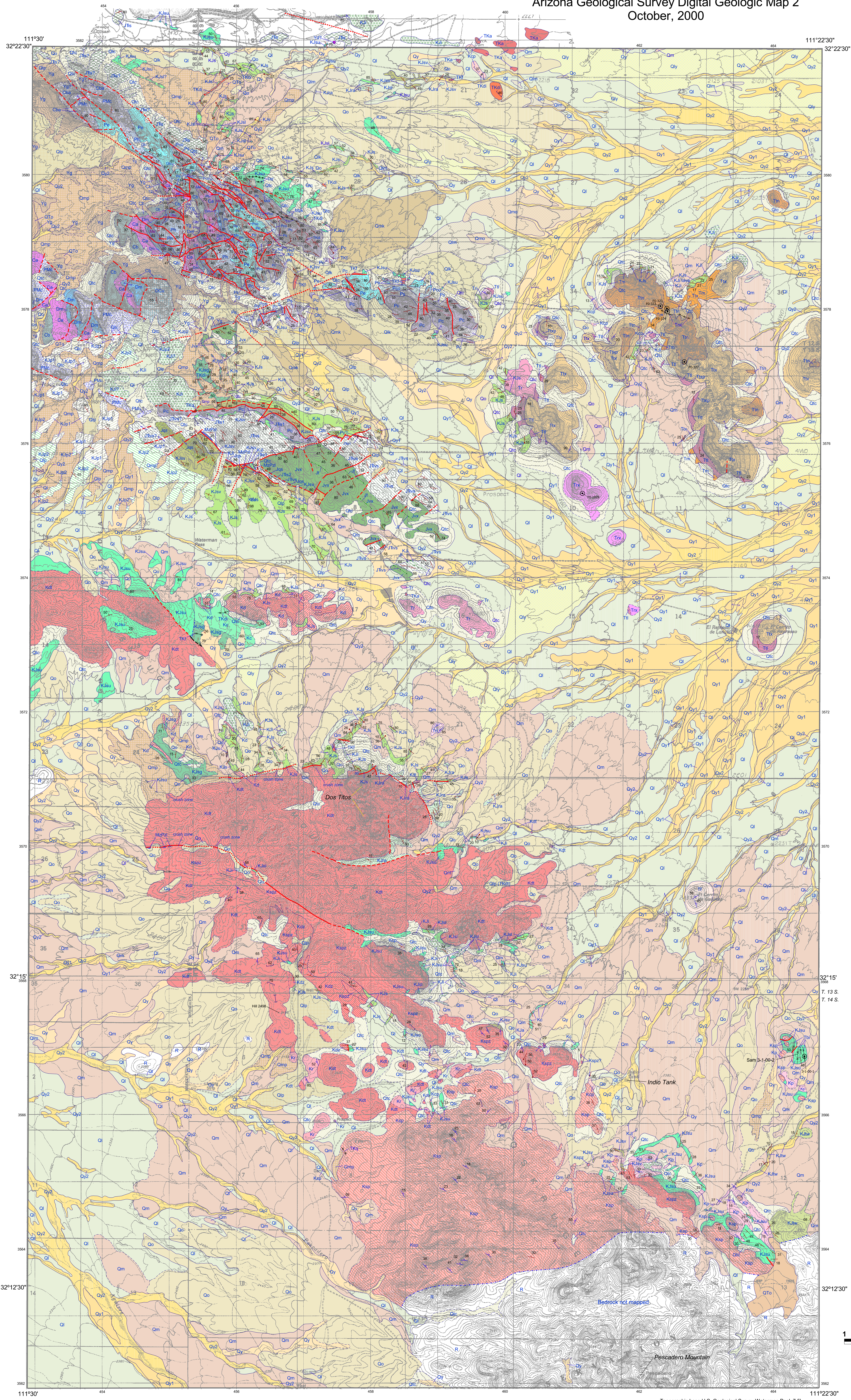


Geologic map of the Waterman Peak and northern La Tortuga Butte 7.5' Quadrangles, Pima County, Arizona

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Explanation

Contacts and Faults

- Contacts**
- Accurately located
 - Approximately located
 - Concealed
 - Nature uncertain
- Faults**
- Accurately located
 - Approximately located
 - Concealed
 - Nature uncertain
- Other symbols**
- Dike (map unit indicated by label)
 - Marker beds (labeled individually)
 - Boundary of mapped area

Structure Symbols

- Bedding, number indicates dip**
- Inclined, upright
 - Inclined, upright, facing indicator observed
 - Vertical
 - Vertical, facing indicator observed
 - Inclined, approximate measurement
 - Inclined, orientation variable
 - Inclined, overturned
 - Inclined, overturned, facing indicator observed
- Foliation, number indicates dip**
- Generic, inclined
 - Flattening foliation in tuff or gneiss flow foliation, inclined
 - Joint, inclined
 - Close disjunct cleavage, inclined
 - Close disjunct cleavage, vertical
- Lamination, number indicates plunge**
- Generic
- Fault orientation**
- Dip direction and magnitude

Map Units

Surficial Geologic Units

Map units consisting of variably consolidated clay, sand, and gravel, differentiated based on soil development, depositional environment, and outcrop morphology

- Qlc** Talus and colluvium (Holocene)
- Qy** Holocene alluvium, undifferentiated (<10 to 10 ka) – Channels and alluvial surfaces of sand and silt, or covered with non-varnished to weakly varnished, angular to subrounded, gravel
- Qyz** Late Holocene alluvium (<4 ka) – Sand, silt and gravel in active channels, low terraces and alluvial fans
- Qy1** Middle Holocene alluvium (<2 to 10 ka) – Surfaces composed of sand and silt, or covered with unvarnished to weakly varnished, angular to subrounded, gravel
- Qly** Late Pleistocene to Holocene alluvium (<10 to 130 ka) – Broadly rounded and slightly to moderately dissected relict alluvial fans and terraces. Consist of slightly reddened late Pleistocene alluvium (Ql) with thin veneers of late Holocene alluvium (Qy).
- Q** Late Pleistocene alluvium (<10 to 130 ka) – Broadly rounded to rounded and moderately dissected relict alluvial fans and terraces; 1 to 2 m of active channel incision; relict bare and wide morphology preserved; deposits consist of gravel, cobbles, and finer-grained sediments.
- Qlp** Late Pleistocene alluvium over pedimented surfaces (<10 to 130 ka) – Fairly planar erosional surfaces cut into bedrock on upper piedmonts with locally thin and patchy veneers of late Pleistocene (Ql) alluvium.
- Qlk** Late Pleistocene alluvium over a petroclastic horizon (<10 to 130 ka) – Surfaces typically 2 to 3 m above active washes, well rounded ridges with coarse surface lag; older petroclastic horizon covered by alluvium <0.5 to 3 m thick and is intermittently exposed.
- Qlm** Late to middle Pleistocene alluvium (<10 to 750 ka) – Broadly rounded surfaces on the piedmont north of the Waterman Mountains; open and loose to moderately packed gravel surface lag; petroclastic horizon often exposed in washes. No noticeable clay is moderately to strongly varnished; sparse relict bars and swales; soil color brown to slightly reddened (like Ql) or like (Qm).
- Qm** Middle Pleistocene alluvium (<130 to 750 ka) – Moderately dissected relict alluvial fans, with several meters of active channel incision; surfaces smooth with moderately to tightly packed cobble pavements; surface lag moderately to strongly varnished; soils contain reddened, clay argillite horizons, with obvious clay skins and subangular blocky structure; stage III to V soil carbonate development.
- Qmp** Middle Pleistocene alluvium over pedimented surfaces (<130 to 750 ka) – Fairly planar erosional surfaces cut into bedrock with thin and patchy veneers of middle Pleistocene (Qm) alluvium; surfaces several meters above active channels; preserved soil characteristic of Qm alluvium; surface lag angular to subrounded.
- Qmk** Middle Pleistocene alluvium over a petroclastic unit (<130 to 750 ka) – Well-rounded rounded ridges with well-developed drainages; surfaces incised 0.5 to 4 m; petroclastic horizon intermittently exposed in drainages and roads; pavement moderately developed; non-limestone clasts moderately to strongly varnished; surface soil horizon is tan to white, carbonate-rich, and littered with fragments from underlying petroclastic horizon.
- Qmo** Middle to early Pleistocene alluvium (<500 ka to 1 Ma) – Moderately dissected relict alluvial fans; broadly rounded ridges not as deeply dissected as Qmk surfaces; non-limestone lag moderately varnished; surface soil horizon is light colored and carbonate-rich and littered with fragments derived from underlying cemented petroclastic horizon.
- Qo** Early Pleistocene alluvium (<750 ka to 2 Ma) – Moderately dissected relict fans with up to 10 m of active channel incision; depth of dissection by channels is similar to Qm channels; soil areas between channels are more rounded by erosion; rock varnish on non-limestone clasts varies from weak to moderate; light colored, carbonate-rich surface soil horizon littered with fragments derived from an underlying petroclastic horizon.
- Qto** Early Pleistocene to Pliocene alluvium (<1 to 5 Ma) – Alluvial fan and terrace remains; surfaces are planar to highly eroded ridges and occupy the highest position in the landscape of any Quaternary unit, at least 10 m above adjacent active channels; surfaces composed of strongly varnished gravel, cobbles, and boulders with an abundance of carbonate litter; stage V pedogenic carbonate development in soil horizon.

Bedrock Geologic Units

- Tertiary volcanic rocks**
- Tk** Mafic dikes (Late Miocene) – Dark colored dikes that contain pyroxene phenocrysts up to 1 cm diameter
 - Tm** Trachyte of Neasay Hill (Oligocene or Miocene) – Moderately crystal-poor, dark gray trachyte lava containing crystals of plagioclase up to 4mm diameter, biotite, and sparse clinopyroxene or amphibole. Trachyte of El Cerro de Represso (Oligocene or Miocene)
 - Tx** Several crystal-rich (25-40%) trachyte lava flow containing plagioclase, biotite, and sparse clinopyroxene or amphibole, and quartz phenocrysts
 - Txp** Crystal poor variety
 - Txx** Crystal-rich rhyolite lava (Oligocene or Miocene) – Rhyolite lava containing 25-35% phenocrysts of quartz, sanidine, plagioclase, and biotite
 - Txi** Crystal-rich rhyolite (Oligocene or Miocene) – Glassy rhyolite dike with ~35% crystals of plagioclase and biotite
 - Tli** Lithic-rich tuff (Oligocene or Miocene) – Non-welded, moderately crystal-rich, quartz phyllite tuff with abundant lithic fragments
 - Tr** Rhyolite lava (Oligocene or Miocene) – Rhyolite lava and breccia, with ~10% crystals of sanidine, quartz, plagioclase, and biotite in variable amounts
 - Tri** Rhyolite intrusions (Oligocene or Miocene) – Flow-banded, crystal poor rhyolite
 - Tf** Felsite of El Cerro de Gallinas (Oligocene or Miocene) – Massive or flow-banded felsite with ~5% crystals of plagioclase, hornblende, and sparse pyroxene
 - Tm** Mafic lava flows (Oligocene or Miocene)
 - Ts** Sandstone and conglomerate (Oligocene or Miocene)

Laramide igneous rocks

- TKq** Felsic quartz porphyry dikes (Paleocene or Cretaceous)
- TKl** Crystal poor felsite (Paleocene or Cretaceous) – Dark greenish gray vitric to light gray aphanitic matrix with rare feldspar crystals
- TKa** Andesitic lava and hypabyssal intrusive rock (Paleocene or Cretaceous)
- TKdi** Intermediate-composition hypabyssal intrusive rock (Paleocene or Cretaceous)
- Kdl** Felsite of Dos Tílos (Cretaceous)
- Kdl** Light gray, very fine-grained granitic rock with sparse crystals of plagioclase, biotite or hornblende, and rare quartz
- Kul** Crystal poor felsite – Light gray microphyre with sparse feldspar crystals
- Ksd** Mixed felsite and mesobasite of the tuff of Sharp Peak
- Ksp** Tuff of Sharp Peak (Cretaceous)
- Ksp** Moderately crystal-rich rhyolite, welded ash-flow tuff, containing crystals of plagioclase, quartz, K-feldspar, and biotite
- Ksp** Mesobasite, angular to sub-angular lapilli to blocks of sandstone and older volcanic rocks
- Kr** Rhyolite lava (Cretaceous) – Light gray, crystal poor rhyolite and rhyolite breccia
- Kcp** Confidence Peak Tuff (Cretaceous) – Crystal-rich welded ash-flow tuff, with crystals of quartz, plagioclase, K-feldspar, and biotite
- Kp** Tuff of San Pedro (Cretaceous) – Crystal-rich biotite-plagioclase welded tuff

Mesozoic Sedimentary and Volcanic rocks

- KJu** Clastic sedimentary rocks, undivided (Cretaceous or Jurassic)
- Kc** Conglomerate (Cretaceous?) – Massive conglomerate that contains boulders of Kik-type felsite-plagioclase sandstone
- KJu2** Sandstone photogeologic unit 2 (Cretaceous or Jurassic) – Vaguely banded outcrop, tan to brown colors, suggest equivalence to KJu
- KJu1** Sandstone photogeologic unit 1 (Cretaceous or Jurassic) – Gray outcrop, bedding not apparent. Probably equivalent to KJu or JJu
- KJu1** Unit of Tunnel Well (Cretaceous or Jurassic) – Massive volcanic lithic conglomerate with gray-green volcanic lithic sand matrix, clasts dominantly andesite
- KJg** Coarse-grained sandstone and conglomerate (Cretaceous or Jurassic) – Generally massive, arkosic to felsite-plagioclase sandstone and conglomerate sandstone with magnesian laminations
- KJs** Sandstone, mudstone, and conglomerate (Cretaceous or Jurassic) – Sandstone brown to gray, arkosic to volcanic-lithic, generally thin to medium bedded
- KJl** Limestone (Cretaceous or Jurassic) – Limestone and sandy limestone predominant over felsite-plagioclase sandstone and shale
- KJb** Reddish felsite-plagioclase sandstone, argillite, and limestone (Cretaceous or Jurassic)
- KJv** Dark volcanic lithic sandstone and conglomerate (Cretaceous or Jurassic)
- KJv** Intermediate composition lava or hypabyssal rocks (Cretaceous or Jurassic) – Dark gray, vesicular basalt or andesite, gray to purplish-gray dacite with plagioclase phenocrysts, and associated intrusive and fragmental rocks
- Jv** Andesite to dacite volcanoclastic breccia (Jurassic?)
- J** Tuff marker beds
- Js** Quartz arenite (Jurassic?) – Tan fine-grained quartz arenite, locally with large-scale cross-bedding
- Jss** Reddish mudstone, siliceous argillite, and quartz-arenite (Jurassic or Triassic)
- Jlv** Red mudstone and volcanic lithic sandstone, with interbedded quartzite in lower part (Jurassic or Triassic)
- Jls** Light gray to white, felsite-plagioclase sandstone, and quartzite cobble conglomerate (Jurassic or Triassic)
- Jk** Karst(?) breccia (Early Mesozoic) – Limestone blocks in red-brown mudstone

Paleozoic sedimentary rocks

- Pt** Relatively (?) Formation (Permian) – Thick bedded to massive, locally cherty limestone and dolomite
- Pc** Cochise Limestone (Permian) – Massive, gray cherty limestone
- Ps** Serrano Formation (Permian) – Tan vitreous quartzite, with red siltstone at base and sparse interbedded dolomite
- Pco** Cochise Limestone (Permian) – Gray, massive to thick-bedded limestone, no chert
- Pp** Early Formation (Permian to Pennsylvanian) – Lower sandstone and shale, with local basal conglomerate, upper sandstone, silt, and dolomite
- PWc** Escabrosa and Horquilla Formations, undivided, photogeologic identification
- Ph** Horquilla Formation (Pennsylvanian) – Massive light gray limestone grading up into limestone, shale, and silt
- Me** Escabrosa Limestone (Mississippian) – Massive, light gray limestone, locally cherty
- DBu** Bolso, Abrego and Martin Formations, undivided, photogeologic identification
- Dm** Martin Formation (Devonian) – Tan and gray, medium-bedded dolomite
- Cba** Bolso and Abrego Formations, undivided
- Ca** Abrego Formation (Middle Cambrian) – Interbedded shale, quartzite, sandstone, and silt
- Cb** Bolso Quartzite (Cambrian) – Red brown to gray quartzite

Igneous rocks (Middle Proterozoic)

- Y** Sierra Ancha Diabase(?) – Dark gray fine-grained diabase
- Yg** Coarse-grained biotite granite

Age uncertain or not specified

- Q** Quartz veins (Tertiary or Mesozoic) – massive white to brown quartz
- R** Bedrock, undifferentiated (Tertiary to Proterozoic) – photogeologically identified bedrock not field checked
- MZp** Limestone (Cretaceous, Jurassic or Paleozoic) – Thin silvers of gray crystalline carbonate along fault zones

Sources of Data

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Location of study area

